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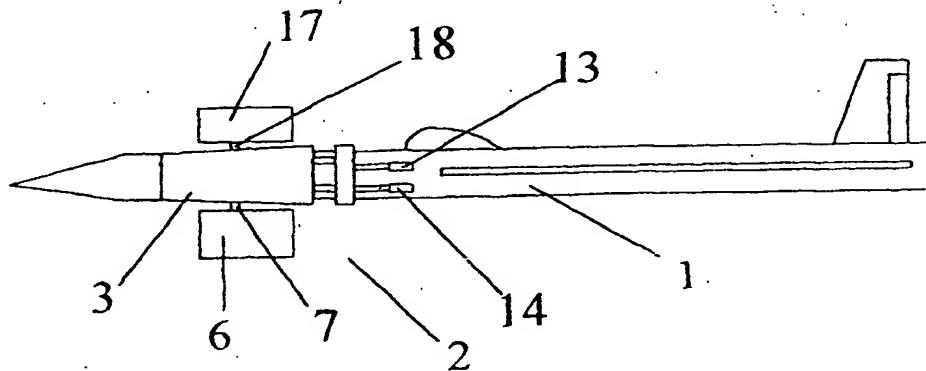
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(57) Abstract: An aircraft (1), e.g. an aeroplane or missile, has fins (6, 17) attached to tube (3) encircling the aircraft fuselage. When fins (6, 17) are pivoted, a predetermined difference in size or pitch of fin (6) relative to fin (17) will cause an aerodynamic imbalance, inducing tube (3) to rotate. This rotation produces a constantly revolving transverse force on the fuselage which induces the craft to automatically follow a spiralling flight path thus evading being hit by anti-aircraft weapons.

AIRCRAFT SPIRALLING MECHANISM - 2

The aim of this invention is to provide an aircraft that has higher chance of surviving attacks from anti-aircraft weapons when flying over enemy territory than aircraft currently in use. The aircraft according to this invention is fitted with a mechanism that enables the aircraft to travel in a continuous spiralling motion while flying over enemy territory, without the need for the pilot to make continuous control adjustments. The mechanism is such that once activated, the spiralling motion is automatic. The mechanism can also be dis-engaged by the pilot when so desired. The spiralling motion is achieved during flight without rolling the aircraft.

While a pilot flying a conventional aircraft such as a jet fighter could make the conventional aircraft fly in a spiralling motion, this could only be achieved if the pilot kept making continuous control changes with his own arm. This could become quite tiresome and strenuous after a while and would require continued concentration, if the spiralling was achieved without rolling the aircraft. Rolling the aircraft, as in the form of a barrel roll, may seem like an easy alternative, but continuous rolling would make the pilot dizzy after a while, leading to loss of control, and if close to the

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ground, a potential for a crash. A continuous rolling motion would also make it hard for the pilot to observe enemy territory, navigate and make target selection. That is, using a sustained rolling motion in order to achieve a prolonged spiralling motion would not be practical.

The aircraft in this invention would allow the pilot to operate conventional controls in a conventional manner, as when flying in a smooth manner, while the aircraft continued to travel in a spiralling motion. The advantage of this is that the pilot would be able to continue to observe enemy territory and would be free to concentrate on targeting enemy sites while the aircraft flew in an evasive manner.

In this invention the spiralling motion of a fast flying aircraft is achieved by using moveable fins on a rotatable tube, with the tube encircling a part of the aircraft (preferably the forward part of the aircraft) and able to rotate around the encircled part of the aircraft. Fitted to a jet aircraft or missile, such as a cruise missile, the rotatable tube would be positioned so that its longitudinal axis would be substantially in alignment with an imaginary longitudinal axis of the aircraft.

The fins are attached to the rotatable tube so that they can be rotated in a pivoting manner relative to the rotatable tube. That is, if the rotatable tube was kept in a fixed

position on the aircraft so as not to rotate, the fin movement would resemble the movement of canards on aircraft such as the Eurofighter and the recent version of the Sukhoi Su-30. The fins would turn in a pitch altering motion in the same direction. With the fins horizontal, the aircraft would be allowed to fly smoothly. When the fins are rotated from the horizontal position, they would act to push the aircraft in a similar manner to the way that canards would (if positioned on the forward part of the aircraft).

For the aircraft to enter a spiralling motion, the fins would need to revolve around the body of the aircraft so that the aircraft is pushed in changing directions. In the invention this is achieved by using the rotatable tube, that allows the fins to revolve around the body of the aircraft - using the rotatable tube as means of travelling around a part of the body of the aircraft. The invention provides a number of means by which rotation of the rotatable tube can be achieved. One way is to use fins that are of unequal size with respect to one another. Having fins that are of unequal size would cause an aerodynamic imbalance when the fins are moved from the horizontal position. With one fin pushing harder than the other, rotation of rotatable tube would result. The rotation of the rotatable tube would be automatic and continuous while

the imbalance between the fins was maintained. Placing the fins back in a horizontal position would remove the imbalance, allowing the rotatable tube to come to rest. Friction between the aircraft and the rotatable tube 5 or a braking mechanism such as a hydraulically activated brake pad being pushed against the rotatable tube could help to stop the rotatable tube from rotating.

Another way of causing the rotatable tube to rotate according to the invention is to increase the pitch of one fin more than that of the other. Increasing the pitch of one fin relative to the other would cause an aerodynamic imbalance on the rotatable tube, thereby forcing it to rotate. Allowing the fins to return to a horizontal position would remove the aerodynamic imbalance, allowing the rotatable tube to come to rest.

Figure 1 shows one form of the aircraft. Shown in Figure 1 is the aircraft 1 as a jet-propelled aeroplane 1, fitted with a spiral inducing assembly 2. The body 4 of the aircraft is in the form of a streamlined fuselage 4.

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Referring to Figure 1, a rotatable tube 3 forming part of the spiral inducing assembly 2 can be seen encircling part of the fuselage 4 of the aeroplane 1. The fuselage has a fore end and an aft end. Referring to this tube 3 as the primary tube 3, the primary tube 3 is able to rotate around the part of the aircraft encircled by the primary tube. The primary tube is shown as being narrower in the front than at the rear. Also shown is another tube 5 that is fitted 10 to the aircraft such that it encircles part of the fuselage 4 of the aircraft. Referring to this tube 5 as the activation tube 5, the activation tube 5 is fitted so that it can be moved in a forward direction relative to the part of the fuselage 4 15 encircled by the activation tube and then back to its original position on the fuselage. Figure 1 also shows the edge of one horizontal fin 6 that is connected to the outside of the primary tube 3. The fin 6 is connected to the outside of primary tube 3 such that it 20 can rotate in a pivoting manner as shown in Figure 2.

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Figure 1A shows an enlarged illustration of the left side of the spiral inducing assembly 2. The fin 6 in Figure 1A is connected to the outside of the primary tube 3 by a connecting joint 7 which is in the form of a connecting rod 7. Extended from the connecting rod 7 in Figure 1A is a protruding section 8 which is used to rotate the connecting rod 7. Rotation of the connecting rod 7 causes the fin 6 to rotate in a pivoting manner around the connecting rod 7 (in the manner shown in Figure 2). Linked to the protruding section 8 in Figure 1A is a stem 9. Referring to this stem 9 as an activation stem 9, the activation stem 9 is used as a means for pushing the protruding section 8 such that when the protruding section 8 is pushed, the protruding section 8 forces the 10 connecting rod 7 to rotate around the longitudinal axis of the connecting rod 7. The activation stem 9 is linked to the protruding section 8 by a rivet 10. The activation stem 9 is shown as being fitted on the outside of the primary tube 3 and is supported on the primary tube 3 by 15 a retaining bracket 11. The retaining bracket 11 is rigidly joined to the primary tube but is channelled to allow the activation stem 9 to move longitudinally between the retaining bracket 11 and the primary

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tube 3. The activation stem 9 is allowed to protrude rearward from the primary tube so that it can be reached by the activation tube 5 when the activation tube 5 is moved forward on the fuselage 4. The activation tube 5 is 20 forced to move forward by an activation mechanism 12 consisting of hydraulic actuators 13 and 14. Figure 3 shows the hydraulic actuators 15 and 16 located on the right side of the spiral inducing assembly 2 which also form part of the activation mechanism 12 by which the activation tube 5 is forced to move. When the hydraulic actuators 13 14 15 and 16 are forced to extend as hydraulic pressure is applied to them, they force the activation tube 5 to move forward as shown in Figure 2. Figure 2 shows that as the activation tube 5 is forced to move forward on the fuselage 4 when the hydraulic actuators 13 and 14 extend, it eventually makes contact with the activation stem 9. As the activation tube 5 is forced to move further forward, it pushes the activation stem 9 forward on primary tube. As the activation stem 9 is pushed forward, the activation stem pushes against the protruding section 8 and moves the protruding section 8, thereby rotating the fin 6 around the connecting rod 7 in a pivoting manner.

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In Figure 2 a rivet 10 is shown connecting the activation stem 9 to the protruding section 8, which allows movement between the activation stem 9 and the protruding section 8. The retaining bracket 11 keeps the activation stem from moving laterally around the primary tube. The retaining bracket 11 however does allow longitudinal sliding movement of the activation stem 9 so that it can be pushed and moved by the activation tube 5.

10 Figure 3 shows the the right side of the spiral inducing assembly 2 of figure 1. Shown is another fin 17, another connecting joint 18 in the form of a connecting rod 18 that connects the fin 17 to the outside of the primary tube 3. Another protruding section 19 is used to rotate 15 the connecting rod 18, and the activation stem 20 is used to push the protruding section 19, with the activation stem 20 linked to the protruding section 19 by a rivet 21. Also visible in Figure 3 is the activation tube 5. The connecting rod 18 allows the fin 17 to rotate 20 in a pivoting manner. Another retaining bracket 22 is shown supporting the respective activation stem 20.

Thus, it can be seen from Figures 1, 1A, 2 and 3 that the activation tube 5, the activation stems 9 and 20, retaining brackets 11 and 22, protruding

sections 8 and 19, rivets 10 and 21 used to connect the activation stems 9 and 20 to respective protruding sections 8 and 19, the connecting joints 7 and 18 in the form of connecting rods 7 and 18, and the activation mechanism 12 5 used to move the activation tube 5 consisting of the hydraulic actuators 13, 14, 15 and 16, collectively form a fin rotating mechanism.

Figure 4 shows the aeroplane 1 of Figure 1 from underneath. It shows that one fin 6 is larger than the other fin 17. 10 When these fins 6 and 17 are rotated in a pivoting manner and in the same direction to the same extent, an aerodynamic imbalance between the fins 6 and 17 arises during flight of the aeroplane because of size difference between the fins 6 and 17. The larger fin 6 will exert a greater magnitude of 15 force on the primary tube 3 during flight of the aeroplane 1 than the smaller fin 17. As a result, the aerodynamic imbalance between the fins 6 and 17 would cause the primary tube 3 to rotate. But both fins 16 and 17 would also be pushing the aircraft laterally, in a similar manner to 20 canards. Thus, because the primary tube 3 is forced to rotate, the lateral force exerted on the aeroplane by the fins 6 and 17 keeps changing, thus forcing the aeroplane to keep changing its direction and hence entering a spiralling motion.

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Figure 5 shows the front cut out of the spiral inducing assembly 2 of figure 1. Shown here is the primary tube 3, the fins 6 and 17, (with fin 6 being larger than fin 17), the fuselage 4 of the aeroplane, the activation stems 9 and 20, linked by rivets 10 and 21 to the protruding sections 8 and 19 respectively, the connecting rods 7 and 18 penetrating the primary tube 3, and with the protruding sections 8 and 19 screwed in the connecting rods 7 and 18 respectively. Figure 5 shows the primary tube 3 as 10 being creased in sections 23, 24 and 25. The creased sections 23, 24 and 25 are used as a means to support the primary tube 3 on the encircled part of the fuselage 4, while allowing for gaps 26 and 27 to exist between the primary tube 3 and the encircled part of the 15 fuselage 4. The gaps 26 and 27 allow the connecting rods 7 and 18 to protrude inwardly through the primary tube 3 without making contact with the encircled part of the fuselage 4. Securing bolt nuts 28 and 29 are shown securing the connecting rods 7 and 18 to the 20 primary tube 3, with thrust bearings 30 and 31 allowing for easy rotation of the connecting rods 7 and 18 around their respective longitudinal axes'.

Figure 6 shows the rear of the primary tube 3 of Figure 1 as a cut out. Shown in Figure 6 are the rear ends of the activation stems 9 and 20, and the retaining brackets 11 and 22 that support the activation stems 9 and 20, and 5 prevent uncontrolled lateral movement of the activation stems 9 and 20. The primary tube 3 is shown as having sections creased 32, 33 and 34.

The primary tube can be formed in various geometric shapes, including cylindrical or cone shaped.

10 Figure 7 shows a side cutting of the part of the fuselage 35 encircled by the primary tube 3 of Figure 1. The encircled part of the fuselage 35 can be seen to be narrower than the rest of the fuselage 4. Thrust bearings 36 and 37 are positioned on the narrowed section of fuselage 35. The 15 thrust bearings are used to support the primary tube and to prevent the primary tube moving longitudinally relative to the fuselage 4.

Figure 8 shows another way that the primary tube 3 of figure 6 can be supported, with wheels 38, 39 and 40 20 attached to the creased sections 32, 33 and 34 of the primary tube 3. The wheels 38, 39 and 40 help to support the primary tube 3 on the encircled part of the fuselage 35.

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Figure 9 shows another way of supporting primary tube 3. Shown is a tube of smaller diameter 41 than the primary tube 3. This smaller tube 41 is a supporting tube 41 in that it can be used to support the primary tube 3. It has a smaller diameter than the primary tube 3 to provide a gap 42 between the primary tube 3 and the supporting tube 41. The gap 42 is used to allow freedom of movement to the protruding sections 8 and 19, and the activation stems 9 and 20 shown positioned inside the primary tube 3. The protruding sections 8 and 19 and the connecting rods 7 and 18 have been formed as moulded units, allowing easier assembly. Bolts 43, 44, 45 and 46 are used to join the primary tube 3 to the supporting tube 41. The supporting tube 41 is able to rotate around the encircled part of the fuselage 35.

Figure 9A shows a side view of an aircraft 1 using the fin rotating mechanism of Figure 9. The activation stem 9 of Figure 9 can be seen to be protruding rearward from inside the primary tube 3.

Figure 10 shows a cut out of the front of the primary tube 3 of Figure 1, but with the protruding sections 8 and 19 protruding from the fins 6 and 17 respectively.

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Figures 11 and 12 show another manner in which the aerodynamic imbalance between the fins can be created during forward flight.

In Figure 11 the protruding section 8, on the left side of the spiral inducing assembly 2 is shorter than the protruding section 19 in Figure 12 on the right side of the spiral inducing assembly 2. The shorter protruding section 8 would generate a greater degree of movement of fin 6 in Figure 11 than the movement of fin 17 that the protruding section 19 would cause in Figure 12 for an equal movement in the respective activation stems 9 and 20. An aerodynamic imbalance between the fins could thus be created.

Figures 13 and 14 show the left and right sides of the spiral inducing assembly 2 of another arrangement for creating an aerodynamic imbalance between the fins 6 and 17. Figure 14 shows the activation stem 20 on the right side as being shorter than the activation stem 9 on the left side in Figure 13. Hence when the activation tube 5 is moved forward, it first starts pushing the activation stem 9 in Figure 13, forcing fin 6 to rotate, and then when the activation tube 5 later starts pushing the activation stem 20 of Figure 14, the activation tube 5 will

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continue pushing the longer activation stem 9 of Figure 13, forcing the fin 6 in Figure 13 into a higher degree of rotation, or pitch, than fin 17 of Figure 14, at all times until both fins are allowed to become horizontal again by the activation tube 5 being allowed to retreat.

Figure 15 shows a spiral inducing assembly 2 with a wheel 47 fitted to the connecting stem 9. The wheel 47 would reduce frictional forces between the activation stem 9 and the activation tube 5 as the activation stem travels around the activation tube 5 when the primary tube is rotating.

Figure 16 shows the spiral inducing assembly of Figure 4 with the fins 6 and 17 of figure 4, and with the primary tube 3 in a state of rotation. It can be seen comparing Figure 4 with Figure 16 how the lateral forces on the aircraft would be constantly changing, enabling the spiral inducing assembly 2, to force the aircraft 1 to travel in a continuous spiralling motion.

Looking at the fins 8 and 17 shown in Figure 16 it can be seen that the rear section of each fin behind the respective connecting rods 7 and 18 is greater than the section of each fin in front the respective connecting rods 7 and 18. This is deliberate. This is used to allow

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the fins to adopt a horizontal position when hydraulic pressure is released from the hydraulic actuators 13, 14 (and 15 and 16 of Figure 3) allowing the activation tube 5 to retreat away from the primary tube 3. Aerodynamic forces are in effect used to allow the fins to return to a resting horizontal position, allowing the aeroplane to re-commence a smooth non-spiralling flight. Friction between activation the activation tube 5 and activation stems 9 and 20 caused by the rotation of the activation stems 9 and 20 around the activation tube (since the activation stems rotate with the primary tube) can be used as a means of slowing the rotation of the primary tube when smooth flight is desired. The braking mechanisms shown in Figures 17 and 18 could also be used as a means of slowing the primary tube when smooth flight needs to be resumed.

Figure 17 shows a side cutting of the primary tube 3 and the part of the fuselage 35 encircled by the primary tube 3. Shown here is a hydraulic actuator 20 48 attached to the encircled part of the fuselage 35, in an extended form. Extended it creates

friction on the primary tube 3 and acts as a brake to help slow the primary tube 3 when the spiral inducing assembly is de-activated. Using a braking system lightly would allow the primary tube 3 to rotate, but would intensify the lateral forces on the aircraft. To allow use of a braking mechanism, the primary tube 3 would be kept smooth and round in the area that friction is induced. Any creased sections 23, 24, 32, 34 would be restricted to areas where the hydraulic actuator 48 would not make contact.

10 Figure 17A shows the hydraulic actuator 48 in a compressed state, as when the primary tube 3 is allowed to freely rotate.

Figure 18 shows another braking mechanism where a lever is used to slow the primary tube. The lever 49 is shown protruding from a hole 50 in the fuselage, and is operated 15 by an actuator in the form of an electric motor 51.

Figure 19 shows the aircraft 1 in the form of a missile 1 with a spiral inducing assembly 2 of Figure 1.

Figure 20 shows a spiral inducing assembly 2 where the primary tube 3 extends over the activation tube 5, but the 20 fin is located on the outside of the primary tube.

The claims defining this invention are as follows:

1. An aircraft comprising a spiral inducing assembly, which said spiral inducing assembly is capable of forcing the aircraft to travel in a spiralling motion during flight of the said aircraft, and which said spiral inducing assembly consists of a tube, and which said tube encircles part of the aircraft and is able to rotate relative to the encircled part of the aircraft, with a plurality of fins connected to the said tube, which said fins are connected to the tube such that the fins protrude laterally outward from the tube and such that the said fins can be rotated in a pivoting manner relative to the tube, and which said spiral inducing assembly comprises a fin rotating mechanism by which fin rotating mechanism the said fins can be rotated in the said pivoting manner, such that the rotation of one fin relative to the tube can result in the rotation of another fin relative to the tube, which fins are such that during flight of the said aircraft one of the said fins connected to the tube can continuously exert a greater magnitude of force on the said tube than can another of the said fins that is connected to the said tube.

2. An aircraft comprising a spiral inducing assembly, which said spiral inducing assembly is capable of forcing the aircraft to travel in a spiralling motion during flight of the said aircraft, and which said spiral inducing assembly consists of a tube, and which said tube encircles part of the aircraft and is able to rotate relative to the encircled part of the aircraft, with a plurality of fins connected to the said tube, which said fins are connected to the tube such that the fins protrude laterally outward from the tube and such that the said fins can be rotated in a pivoting manner relative to the tube, and which said spiral inducing assembly comprises a fin rotating mechanism by which fin rotating mechanism the said fins can be rotated in the said pivoting manner, such that the rotation of one fin relative to the tube can result in the rotation of another fin relative to the tube, which fins are such that during flight of the said aircraft one of the said fins connected to the tube can continuously exert a greater magnitude of force on the said tube than can another of the said fins that is connected to the said tube.

3. An aircraft comprising a spiral inducing assembly, which said spiral inducing assembly is capable of forcing the aircraft to travel in a spiralling motion during flight of the said aircraft, and which said spiral inducing assembly consists of a tube, and which said tube encircles part of the aircraft and is able to rotate relative to the encircled part of the aircraft, with a plurality of fins connected to the said tube, which said fins are connected to the tube such that the fins protrude laterally outward from the tube and such that the said fins can be rotated in a pivoting manner relative to the tube, and such that the said fins can be rotated in the said pivoting manner in the same direction, and which said spiral inducing assembly comprises a fin rotating mechanism by which said fin rotating mechanism the said fins can be rotated in the said pivoting manner in the same direction as each other and by which said fin rotating mechanism the said fins can be rotated in the said same direction relative to the tube such that the rotation of one fin relative to the tube can result in the rotation of another fin to a greater degree of rotation relative to the tube and such that one of the said fins connected to the tube can be rotated to a greater degree relative to the tube than can another of the said fins that is connected to the said tube.

4. An aircraft comprising a spiral inducing assembly, which said spiral inducing assembly is capable of forcing the aircraft to travel in a spiralling motion during flight of the said aircraft and which said spiral inducing assembly consists of a tube, and which said tube encircles part of the aircraft and is able to rotate relative to the encircled part of the aircraft, with a plurality of fins connected to the said tube, which said fins are connected to the tube such that the fins protrude laterally outward from the tube and such that the said fins can be rotated in a pivoting manner relative to the tube, and such that the said fins can be rotated in the said pivoting manner in the same direction, and which said spiral inducing assembly comprises a fin rotating mechanism by which said fin rotating mechanism the said fins can be rotated in the said pivoting manner in the same direction as each other such that the rotation of one fin relative to the tube results in the rotation of another fin relative to the tube, and with the said fins being such that one of said fins connected to the tube is larger than another of the said fins.

5. The aircraft of claim 1 wherein the said fin that is able to exert a greater magnitude of force on the tube can be pivotally rotated to a greater degree than the said other fin by means of the fin rotating mechanism, such that when the said fin that can be rotated to greater degree is rotated to a greater degree than the said other fin, the fin that is rotated to greater degree exerts a greater magnitude of force on the tube during flight of the aircraft than the said other fin.

6. The aircraft of claim 1 wherein the said fin that is able to exert a greater magnitude of force on the tube is larger than the said other fin such that by being larger the fin that is larger can exert a greater magnitude of force on the tube than the said other fin during flight of the aircraft.

7. The aircraft of claim 2 wherein the said fin that is able to exert a greater magnitude of force on the tube can be pivotally rotated to a greater

degree than the other said fin by means of the fin rotating mechanism, such that when the said fin that can be rotated to greater degree is rotated to a greater degree than the said other fin, the fin that is rotated to greater degree exerts a greater magnitude of force on the primary tube during flight of the aircraft than the said other fin.

8. The aircraft of claim 2 wherein the said fin that is able to exert a greater magnitude of force on the tube is larger than the said other fin such that by being larger the fin that is larger can exert a greater magnitude of force on the tube than the said other fin during flight of the aircraft.

9. An aircraft comprising a spiral inducing assembly, which said spiral inducing assembly is capable of forcing the aircraft to travel in a spiralling motion during flight of the said aircraft, and which said spiral inducing assembly consists of a tube, and which said tube encircles part of the aircraft and is able to rotate relative to the encircled part of the aircraft, with

5. a plurality of fins connected to the said tube, which said fins are connected to the tube such that the fins protrude laterally outward from the tube and such that the said fins can be rotated in a pivoting manner relative to the tube, and such that the said fins can be rotated in the said pivoting manner in the same direction and in unison relative to the tube and which said spiral inducing assembly comprises a fin rotating mechanism by which said fin rotating mechanism the said fins can be rotated in the said pivoting manner in unison in the same direction as each other relative to the tube such that the rotation of one fin relative to the tube can result in the rotation of another fin relative to the tube, and with the said fins being such that during flight of the said aircraft one of the said fins connected to the tube can continuously exert a greater magnitude of force on the said tube than can another of the said fins that is connected to the said tube.

10. The aircraft of claim 9 wherein the said fin that is able to exert a greater magnitude of force on the tube is larger than the said other fin such that by being larger the fin that is larger is able to exert a greater magnitude of force on the tube than the said other fin during flight of the aircraft.

11. The aircraft of claim 1 wherein the spiral inducing assembly is such that if the said aircraft travelled in a horizontal direction, the airflow encountered by the spiral inducing assembly could cause the spiral inducing assembly to force the aircraft to travel in spiralling motion, but with the aircraft being able to continue flying in a mainly horizontal direction.

12. The aircraft of claim 1 wherein the spiral inducing assembly can force the aircraft to travel in a spiralling motion without having to roll the aircraft to achieve the spiralling motion.

13. The aircraft of claim 1 wherein the tube is positioned on the said aircraft such that during flight of the aircraft if the aircraft travelled in a linear direction, the longitudinal axis of the said tube would be substantially in alignment with the said linear direction if the spiral inducing assembly did not cause the aircraft to travel in a spiralling motion.

14. The aircraft of claim 1 wherein the spiral inducing assembly can force the said aircraft to travel in a continuous spiralling motion while the said fins are continuously maintained in a rigid position with respect to the said tube.

15. The aircraft of claim 1 wherein the said fins can be rotated in a pivoting manner and in the same direction relative to the said tube such that if the aircraft had two sides, and if while looking at one side of the aircraft a fin could be seen to be rotating in a clockwise direction, then if the other side of the aircraft had been looked at instead of the first said side, and another fin was seen to be rotating while looking at the said other side of the aircraft, the said other fin would have been seen to be rotating in an anti-clockwise manner.

16. The aircraft of claim 1 wherein the said fin that is able to continuously exert a greater magnitude of force on the tube than another fin is able to exert a greater magnitude of force on the tube continuously throughout numerous complete revolutions of the tube around the encircled part of the said aircraft during flight of the said aircraft.

17. The aircraft of claim 1 wherein the said aircraft is an aeroplane.

18. The aircraft of claim 1 wherein the said aircraft is a missile.

19. The aircraft of claim 16 wherein the said fins can be rotated in a pivoting manner and in the same direction relative to the said tube such that if the aircraft had two sides, and if while looking at one side of the aircraft a fin could be seen to be rotating in a clockwise direction, then if the other side of the aircraft had been looked at instead of the first said side, and another fin was seen to be rotating while looking at the said other side of the aircraft, the said other fin would have been seen to be rotating in an anti-clockwise manner.

20. The aircraft of claim 15 wherein the said fin that is able to continuously exert a greater magnitude of force on the tube than another fin is able to exert a greater magnitude of force on the tube continuously throughout numerous complete revolutions of the tube around the encircled part of the said aircraft during flight of the said aircraft.

21. The aircraft of any one of claims 1 to 20 wherein the said tube is cylindrical.

22. The aircraft of any one of claims 1 to 20 wherein the said tube is in the form of a geometric shape other than cylindrical.

23. The aircraft of any one of claims 1 to 20 wherein the said tube is formed such that a section of the tube is narrower than another section of the tube.

24. The aircraft of any one of claims 1 to 20 wherein a section of the tube is creased.

25. The aircraft of any one of claims 1 to 20 wherein when one fin is horizontal the surface area on top of that fin is greater than the surface area on top of another fin when both fins are horizontal.

26. The aircraft of any one of claims 1 to 14 or 16 to 18 wherein the said fins can be rotated in a pivoting manner and in the same direction relative to the said tube such that if the aircraft had two sides, and if while looking at one side of the aircraft a fin could be seen to be rotating in a clockwise direction, then if the other side of the aircraft had been looked at instead of the first said side, and another fin was seen to be rotating while looking at the said other side of the aircraft, the said other fin would have been seen to be rotating in an anti-clockwise manner.

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27. The aircraft of any one of claims 1, 2, 5 to 15, 17 or 18 wherein the fin that is able to continuously exert a greater magnitude of force on the tube than another fin is such that it is able to exert a greater magnitude of force on the tube continuously throughout numerous complete revolutions of the tube around the encircled part of the said aircraft during flight of the said aircraft than the said other fin is able to.

10 28. The aircraft of any one of claims 1, 2, 5 to 14 or 16 to 18 wherein the said fins can be rotated in a pivoting manner and in the same direction relative to the said tube such that if the aircraft had two sides, and if while looking at one side of the aircraft a fin could be seen to be rotating in a clockwise direction, then if the other side of the aircraft had been looked at instead of the first said side, and another fin was seen to be rotating while looking at the said other side of the aircraft, the said other fin would have been seen to

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be rotating in an anti-clockwise manner, with the said fin that is able to exert a greater magnitude of force on the tube during flight of the said aircraft than another fin is also able to exert an equal magnitude of force on the tube during flight of the said aircraft as the said other fin.

29. The aircraft of claim 27 wherein the said fin that is able to exert a greater magnitude of force on the tube during flight of the said aircraft than another fin is also able to exert an equal magnitude of force on the tube during flight of the said aircraft as the said other fin.

10 30. The aircraft of any one of claims 2 to 10 wherein the spiral inducing assembly is such that if the said aircraft travelled in a horizontal direction, the airflow encountered by the spiral inducing assembly could cause the spiral inducing assembly to force the aircraft to travel in spiralling motion, but with the aircraft being able to continue flying in a mainly horizontal direction.

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20 31. The aircraft of any one of claims 2 to 10 wherein the spiral inducing assembly can force the aircraft to travel in a spiralling motion without having to roll the aircraft to achieve the spiralling motion.

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32. The aircraft of any one of claims 2 to 10 wherein the tube is positioned on the said aircraft such that during flight of the aircraft if the aircraft travelled in a linear direction, the longitudinal axis of the said tube would be substantially in alignment with the said linear direction if the spiral inducing assembly did not cause the aircraft to travel in a spiralling motion.

10 33. The aircraft of any one of claims 2 to 10 wherein the spiral inducing assembly can force the said aircraft to travel in a continuous spiralling motion while the said fins are continuously maintained in a rigid position with respect to the said tube.

15 34. The aircraft of any one of claims 2 to 10 wherein the said aircraft is an aeroplane.

35. The aircraft of any one of claims 2 to 10 wherein the said aircraft is a missile.

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36. The aircraft of any one of claims 1 to 20, 21, 22, 23, 24, 25, 27, 28, 29, 30, 31, 32, 33, 34, or 35 wherein the aircraft comprises a body, and the tube that encircles part of the aircraft encircles part of the body of the aircraft and is able to rotate relative to the encircled part of the body of the aircraft, with a stem connected to one fin and another stem is connected to another fin, and with an additional tube encircling part of the body of the aircraft, which body comprises a fore end and an aft end, and which said additional tube is able to move between the fore end and the aft end of the body, with at least one hydraulic actuator connected to the body, which hydraulic actuator is connected to the body of the aircraft such that the hydraulic actuator is able to push the additional tube and force the additional tube to move between the fore end and the aft end of the body, such that as the additional tube is moved the additional tube can be pressed against the said stems, with the stems connected to the respective fins by such means that as the

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additional tube presses against the stems the respective fins are rotated in a pivoting manner with respect to the tube that is able to rotate relative to the body of the aircraft, and with the stems of such relative lengths with respect to one another, the fins of such relative sizes with respect to one another, and with the stems connected to the respective fins by such means that during flight of the said aircraft one of the said fins can be made to continuously exert a greater magnitude of force on the said tube that is able to rotate relative to the body of the aircraft than another fin is able to exert on the tube that is able to rotate relative to the body of the aircraft, with the fin rotating mechanism comprising the stems, the means for connecting the stems to the respective fins, the hydraulic actuator and the additional tube.

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37. The aircraft of any one of claims 1 to 20, 21, 22, 23, 24, 25, 27, 28, 29, 30, 31, 32, 33, 34, or 35 wherein the said tube is a primary tube and one of the said fins is connected to the said primary tube such that the fin is a primary fin and is located on the outside of the said primary tube, with a connecting joint used to connect the said primary fin to the said primary tube such that the fin can be rotated relative to the primary tube in a pivoting manner, which said connecting joint is a primary connecting joint and which said primary connecting joint has a protruding section, which protruding section is a primary protruding section, and which said primary protruding section is connected to a stem, which stem is a primary activation stem, with another fin, which is a secondary fin, connected to the said primary tube such that the secondary fin is located on the outside of the said primary tube, with a connecting joint used to connect the said secondary fin to the said primary tube such that the said secondary fin can be rotated relative to the primary tube in a pivoting manner.

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which said connecting joint that is used to connect the secondary fin is a secondary connecting joint and which said secondary connecting joint has a protruding section which is a secondary protruding section, and which said secondary protruding section is connected to a stem, which stem is a secondary activation stem, with another tube, which is an activation tube, positioned on the aircraft such that the said activation tube encircles part of the aircraft and such that the said activation tube can be moved relative to the said primary tube, with an actuation mechanism used to forcefully move the said activation tube and such that as the activation tube is forcefully moved relative to the said primary tube, pressure can be applied to the said primary activation stem and the secondary activation stem through the movement of the said activation tube, and such that the primary activation stem and secondary activation stem can thus be pushed, and as the primary activation stem is pushed, the said primary protruding section of the primary connecting joint is moved such that the said primary

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connecting joint is rotated, and such that as the said primary connecting joint is rotated, the said primary fin is rotated relative to the primary tube, and as the secondary activation stem is pushed the said secondary protruding section of the secondary connecting joint is moved such that the said secondary connecting joint is rotated and such that as the said secondary connecting joint is rotated, the said secondary fin is rotated relative to the primary tube, such that the primary protruding section, the secondary protruding section, the primary connection stem, the secondary connection stem, the primary connecting joint, the secondary connecting joint, the activation tube and the actuation mechanism used to move activation tube form a fin rotating mechanism, with the said fins being of such relative sizes with respect to one another, the said protruding sections being of such relative lengths with respect to one another, and the activation stems being of such relative lengths with respect to one another that during flight of the said aircraft one of the said fins can be made to exert a greater magnitude of force on the said primary tube than another fin.

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38. The aircraft of claim 37 wherein the primary connecting joint is a rod attached and fastened to the primary tube such that the rod can be rotated around its longitudinal axis, which said rod is a primary connecting rod, and the secondary connecting joint is another rod attached and fastened to the primary tube, which said other rod is a secondary connecting rod and is attached and fastened to the primary tube such that the secondary connecting rod can be rotated around its longitudinal axis, with the primary protruding section protruding at an angle to the longitudinal axis of the said primary connecting rod, and the secondary protruding section protruding at an angle to the longitudinal axis of the said secondary connecting rod.

39. The aircraft of claim 38 wherein the said primary connecting rod penetrates inwardly through the said primary tube, and the said secondary connecting rod penetrates inwardly through the primary tube.

40. The aircraft of claim 36 wherein the additional tube is of such short length that it is in the form of a ring.

20 41. The aircraft of claim 37 wherein the length of one protruding section is shorter than the length of another protruding section.

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42. The aircraft of any one of claims 36 or 37 wherein the length of one stem is shorter than the length of another stem.

43. The aircraft of claim 37 wherein the actuation mechanism used to move the said activation tube relative to the said primary tube is achieved by a plurality of hydraulic actuators connected between a part of the aircraft and the activation tube, such that by extending the hydraulic actuators, the activation tube is forced to move in the direction of the said primary activation stem and the secondary activation stem, such that the primary activation stem and the secondary activation stem can be forced to move by movement of the activation tube.

15 44. The aircraft of claim 37 wherein another tube, which is a supporting tube, and is of a diameter smaller than the said primary tube, and which said supporting tube encircles part of the aircraft and is able to rotate relative to the part of the aircraft encircled by the

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supporting tube, with the primary tube encircling the said supporting tube such that the longitudinal axis of the primary tube is aligned with the longitudinal axis of the supporting tube and with the primary tube firmly fixed to the said supporting tube such that both the primary tube and the supporting tube are able to rotate relative to the encircled part of the aircraft and such that circumference of the outer surface of the said supporting tube is smaller than the circumference of the inner surface of the said primary tube such that a gap exists between the said primary tube and the said supporting tube, with the primary protruding section, the primary activation stem, the secondary protruding section and the secondary activation stem positioned between the primary tube and the supporting tube, with a plurality of bolts used to connect the said primary tube to the said supporting tube.

45. The aircraft of claim 37, wherein rivets are used to connect the primary activation stem to the primary protruding section and the secondary activation stem to the secondary protruding section.

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46. The aircraft of claim 36 wherein the said additional tube is cylindrical.

47. The aircraft of claim 36 wherein the said additional tube is in the form of a geometric shape other than cylindrical.

48. The aircraft of claim 36 wherein the said additional tube is formed such that a section of the additional tube is narrower than another section of the tube.

49. The aircraft of claim 36 wherein a section of the additional tube is creased.

50. The aircraft of claim 37 wherein the said activation tube is in the form of a geometric shape other than cylindrical.

51. The aircraft of claim 37 wherein the said activation tube is formed such that a section of the activation tube is narrower than another section of the tube.

52. The aircraft of claim 37 wherein a section of the activation tube is creased.

53. The aircraft of claim 37 wherein the said activation tube is of such short length that it is in the form of a ring.

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54. The aircraft of claim 37 wherein the said primary activation stem and secondary activation stem are positioned longitudinally with respect to the longitudinal axis of the said primary tube.

5 55. The aircraft of claim 37 wherein movement of the primary activation stem and secondary activation stem is achieved by the activation tube being pressed directly against the primary activation stem and the secondary activation stem.

10 56. The aircraft of claim 37 wherein movement of the primary activation stem and secondary activation stem is achieved by the activation tube being pressed against intermediary substances positioned between the activation tube and the primary activation stem and between the activation tube and secondary activation stem, such that the activation tube is not in direct contact with the primary activation stem and the secondary activation stem.

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57. The aircraft of claim 56 wherein the said intermediary substances are wheels connected to the said primary activation stem and the secondary activation stem such that the said wheels are able to rotate and are interposed between the said primary activation stem and activation tube and between the secondary activation stem and the activation tube such that said wheels are able to travel around the activation tube when the activation tube is pressed against the said wheels.

10 58. The aircraft of claim 37 wherein the said activation tube is located within the said primary tube.

59. The aircraft of claim 37 wherein the said activation tube encircles a part of the aircraft not encircled by the primary tube.

15 60. The aircraft of claim 37 wherein the the said primary activation stem and secondary activation stem are positioned within the primary tube.

61. The aircraft of claim 37 wherein the primary protruding section and the primary connecting joint are formed as a moulded unit, and the secondary protruding section and the secondary connecting joint are formed as a moulded unit.

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62. The aircraft of claim 37 wherein the primary protruding section is screwed into the primary connecting joint and the secondary protruding section is screwed into the secondary connecting joint.

5 63. The aircraft of claim 37 wherein retaining brackets within and attached to the primary tube are used to limit the amount lateral movement of the said primary activation stem and the secondary activation stem relative to the longitudinal axis of the primary tube.

10 64. The aircraft of claim 37 wherein the primary connecting joint is a rod attached and fastened to the primary tube such that the rod penetrates inwardly through the primary tube and can rotate relative to the primary tube, which said rod is a primary connecting rod, and the secondary connecting joint is another rod attached and fastened to the primary tube, which said other rod is a secondary connecting rod and which said secondary connecting rod is attached and fastened to the primary tube such that it penetrates inwardly through the primary tube and such that it can rotate relative to the primary

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5 tube, with the primary protruding section protruding at an angle to the longitudinal axis of the said primary connecting rod, and the secondary protruding section protruding at an angle to the longitudinal axis of the said secondary connecting rod, with the primary protruding section and the secondary protruding section positioned within the primary tube, and with the activation tube encircling a part of the aircraft that is not encircled by the primary tube, with movement of the said activation tube relative to the said primary tube achieved by a plurality of hydraulic actuators connected between a part of the aircraft and the activation tube, such that by extending the hydraulic actuators, the activation tube is forced to move in the direction of the said primary tube, the primary activation stem and the secondary activation stem and can be pressed against the primary activation stem and the secondary activation stem, such that the primary activation stem and secondary activation stem can be forced to move by movement of the activation tube,

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whereby as the activation tube is moved relative to the said primary tube, pressure can be applied to the said primary activation stem and the secondary activation stem through the movement of the said activation tube and such that the primary activation stem and secondary activation stem can thus be pushed, and as the primary activation stem is pushed the said primary protruding section of the primary connecting rod is moved such that the said primary connecting rod is rotated around the longitudinal axis of the said primary connecting rod, and such that as the said primary connecting rod is rotated, the said primary fin is rotated around the longitudinal axis of the said primary connecting rod, and as the secondary activation stem is pushed the said secondary protruding section of the secondary connecting rod is moved such that the said secondary connecting rod is rotated around the longitudinal axis of the said secondary connecting rod, and such that as the said secondary connecting rod is rotated, the said secondary fin is rotated around the

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longitudinal axis of the said secondary connecting rod, with another tube, which is a supporting tube and is of a diameter smaller than the said primary tube, and which said supporting tube encircles part of the aircraft and is able to rotate relative to the part of the aircraft encircled by the supporting tube, with the primary tube encircling the said supporting tube such that the longitudinal axis of the primary tube is aligned with the longitudinal axis of the supporting tube and with the primary tube firmly fixed to the said supporting tube such that both the primary tube and the supporting tube are able to rotate relative to the part of the aircraft encircled by the primary tube and the supporting tube and such that circumference of the outer surface of the said supporting tube is smaller than circumference of the inner surface of the said primary tube such that a gap exists between the said primary tube and the said supporting tube, with the primary protruding section, the primary activation stem, the secondary protruding section and the secondary activation stem positioned

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between the primary tube and the supporting tube, with a plurality of bolts used to connect the the said primary tube to the said supporting tube, and with the said fin rotation mechanism consisting of the primary protruding section, the secondary protruding section, the primary activation stem, the secondary activation stem, the activation tube and the hydraulic actuators, with the primary activation stem being of shorter length than the secondary activation stem, and with retaining brackets on the primary tube that are used to limit the amount lateral movement of the said primary activation stem and secondary activation stem relative to the longitudinal axis of the primary tube.

65. The aircraft of any one of claims 1 to 20 wherein the tube that is able to rotate around an encircled part of the aircraft is a primary tube, and one of the said fins connected to the said tube is a primary fin, with a connecting joint used to connect the said primary fin to the said primary tube such that the fin can be rotated relative

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to the primary tube in a pivoting manner, which said connecting joint is a primary connecting joint and which said primary fin has a protruding section, which protruding section is a primary protruding section, and which said primary protruding section is connected to a stem, which stem is a primary activation stem, with another fin that is connected to the primary tube, which is a secondary fin, with a connecting joint used to connect the said secondary fin to the said primary tube such that the said secondary fin can be rotated relative to the primary tube in a pivoting manner, which said connecting joint that is used to connect the secondary fin is a secondary connecting joint, and which said secondary fin has a protruding section which is a secondary protruding section, and which said secondary protruding section is connected to a stem, which stem is a secondary activation stem, with another tube, which is an activation tube, positioned on the aircraft such that the said activation tube encircles

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part of the aircraft and such that the said activation tube can be moved relative to the said primary tube, with an actuation mechanism used to forcefully move the said activation tube and such that as the activation tube is forcefully moved relative to the said primary tube, pressure can be applied to the said primary activation stem and the secondary activation stem through the movement of the said activation tube and such that the primary activation stem and secondary activation stem can thus be pushed, and as the primary activation stem is pushed the said primary protruding section of the primary fin is moved such that the said primary fin is pivotally rotated relative to the primary tube, and as the secondary activation stem is pushed the said secondary protruding section of the secondary fin is moved such that the said secondary fin is pivotally rotated relative to the primary tube, such that the primary protruding section, the secondary protruding section, the primary activation stem,

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the secondary activation stem, the primary connecting joint, the secondary connecting joint, the activation tube and the actuation mechanism used to move activation tube form a fin rotating mechanism, with the said fins being of such relative sizes with respect to one another, the said protruding sections being of such relative lengths with respect to one another, and the activation stems being of such relative lengths with respect to one another that during flight of the said aircraft one of the said fins can be made to exert a greater magnitude of force on the said primary tube than another fin when the fins are rotated in the same direction.

66. The aircraft of claim 65 wherein when one fin is horizontal the surface area on top of that fin is greater than the surface area of another fin when both fins are horizontal.

67. The aircraft of claim 65 wherein the length of one protruding section is shorter than the length of another protruding section.

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68. The aircraft of claim 65 wherein the length of one activation stem is shorter than the length of another activation stem.

69. The aircraft of claim 65 wherein the actuation mechanism used to move the said activation tube relative to the said primary tube is achieved by a plurality of hydraulic actuators connected between a part of the aircraft and the activation tube, such that by extending the hydraulic actuators, the activation tube is forced to move closer to the said primary activation stem and secondary activation stem, such that the primary activation stem and the secondary activation stem are able to be forced to move by movement of the activation tube.

70. The aircraft of claim 65 wherein retaining brackets on the primary tube are used to limit the amount lateral movement of the said primary activation stem and secondary activation stem relative to the primary tube.

71. The aircraft of claim 37 wherein retaining brackets on the primary tube are the means to limit the amount lateral movement of the said primary activation stem and secondary activation stem relative to the primary tube.

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72. The aircraft of claim 65 wherein the said primary tube is cylindrical.

73. The aircraft of claim 65 wherein the said primary tube is of a geometric shape other than cylindrical.

74. The aircraft of claim 65 wherein the said primary tube is formed such that a section of the primary tube is narrower than another section of the primary tube.

75. The aircraft of claim 65 wherein a section of the primary tube is creased.

76. The aircraft of claim 65 wherein the said activation tube is of such short length that it is in the form of a ring.

77. The aircraft of claim 65 wherein the said activation tube is in the form of a geometric shape other than cylindrical.

78. The aircraft of claim 65 wherein the said activation tube is formed such that a section of the activation tube is narrower than another section of the tube.

79. The aircraft of claim 65 wherein a section of the activation tube is creased.

80. The aircraft of claim 65 wherein the said primary activation stem and secondary activation stem are positioned primarily longitudinally with respect to the longitudinal axis of the said primary tube.

5 81. The aircraft of claim 65 wherein movement of the primary activation stem and the secondary activation stem is achieved by the activation tube being pressed directly against the primary activation stem and the secondary activation stem.

10 82. The aircraft of claim 65 wherein movement of the primary activation stem and secondary activation stem is achieved by the activation tube being pressed against intermediary substances positioned between the activation tube and the primary activation stem and between the activation tube and secondary activation stem, such that activation tube is not in direct contact with the primary activation stem and the secondary activation stem.

15 83. The aircraft of claim 65 wherein the said activation tube encircles a part of the aircraft that is not encircled by the primary tube.

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84. The aircraft of any one of claims 1 to 83 wherein sections of one of the said fins are such that when the fin is pivotally rotated around the said tube that is able to rotate around an encircled part of the aircraft, such that the fin has an axis of pivoting rotation, a section of the fin extending laterally from the axis of pivoting rotation is not symmetrical with respect to another section of the said fin extending laterally from the axis of pivoting rotation.

10 85. The aircraft of any one of claims 1 to 83 wherein sections of one of the said fins are such that when the fin is pivotally rotated around the said primary tube, a section of the fin on one side of the axis of rotation is not symmetrical with respect to another section of the said fin on the other side of the axis of rotation.

15 86. The aircraft of any one of claims 1 to 85 wherein sections of the tube that is able to rotate around an encircled part of the aircraft are creased and wheels are attached to the said creased sections such that the wheels are able to freely wheel on the creased sections.

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87. The aircraft of any one of claims 1 to 86 wherein a friction inducing mechanism connected to the aircraft is used as a means to induce a frictional force against the spiral inducing assembly.

5 88. The aircraft of any one of claims 1 to 88 wherein a hydraulic actuator connected to the aircraft is able to be extended such that hydraulic actuator is able to create a frictional force against the tube that is able to rotate around an encircled part of the aircraft.

10 89. The aircraft of any one of claims 1 to 88 wherein a lever is connected to the aircraft, which lever can be pressed against the tube that is able to rotate around an encircled part of the aircraft, such that a frictional force can be created by pressing the lever against the tube that is able to rotate around an encircled part of the aircraft.

15 90. The aircraft of any one of claims 1 to 16, 19 or 20 wherein the said aircraft is an aeroplane.

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81. The aircraft of any one of claims 1 to 18, 19 or 20 wherein the said aircraft is a missile.

82. The aircraft of claim 36 wherein the said tube that is able to rotate around the encircled part of the aircraft is in the form of a cone.

83. The aircraft of any one of claims 1 to 14 or 16 to 18 wherein the said fins can be rotated in a pivoting manner and in the same direction relative to the said primary tube such that if the aircraft had two sides, and if while looking at one side of the aircraft a fin could be seen to be rotating in a clockwise direction, then if the other side of the aircraft had been looked at instead of the first said side, and another fin was seen to be rotating while looking at the said other side of the aircraft, the said other fin would have been seen to be rotating in an anti-clockwise manner, and where the said same direction of rotation of the fins is such that the direction of rotation of one fin is substantially the same as that of another.

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94. The aircraft of any one of claims 1, 2, 5 to 15, 17 or 18 wherein the fin that is able to continuously exert a greater magnitude of force on the primary tube than another fin such that it is able to exert a greater magnitude of force on the primary tube continuously throughout numerous complete revolutions of the primary tube around the encircled part of the said aircraft during flight of the said aircraft than the said other fin is able to, and where the said same direction of rotation of the fins is such that the direction of rotation of one fin is substantially the same as that of another.

95. The aircraft of claim 94 wherein the said fin that is able to exert a greater magnitude of force on the primary tube during flight of the said aircraft than another fin is also able to exert an equal magnitude of force on the primary tube during flight of the said aircraft as the said other fin.

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96. The aircraft of any one of claims 1, 2, 5 to 14 or 16 to 18 wherein the said fins can be rotated in a pivoting manner and in the same direction relative to the said primary tube such that if the aircraft had two sides, and if while looking at one side of the aircraft a fin could be seen to be rotating in a clockwise direction, then if the other side of the aircraft had been looked at instead of the first said side, and another fin was seen to be rotating while looking at the said other side of the aircraft, the said other fin would have been seen to be rotating in an anti-clockwise manner, and where the said same direction of rotation of the fins is such that the rotation of one fin is substantially the same as that of another with the said fin that is able to exert a greater magnitude of force on the primary tube during flight of the said aircraft than another fin is also able to exert an equal magnitude of force on the primary tube during flight of the said aircraft as the said other fin.

97. An aircraft with a spiral inducing assembly substantially as herein described with reference to the accompanying drawings.

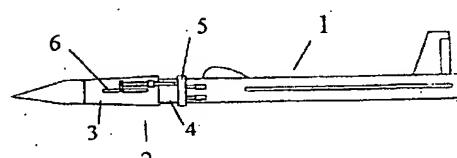


FIGURE 1

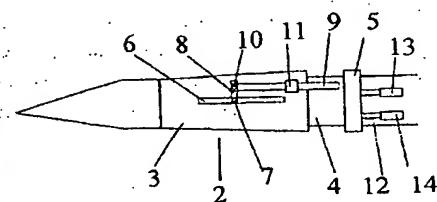


FIGURE 1A

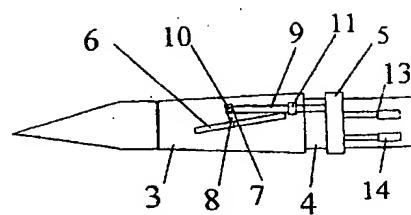


FIGURE 2

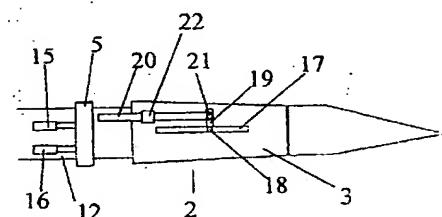


FIGURE 3

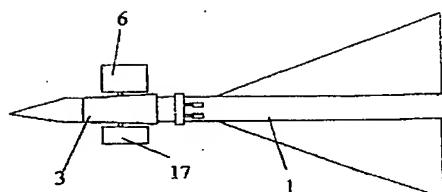


FIGURE 4

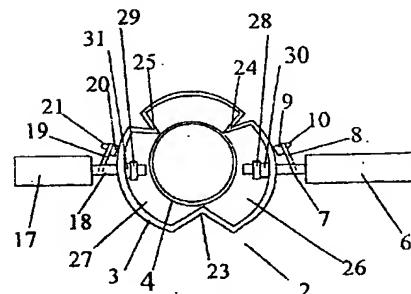


FIGURE 5

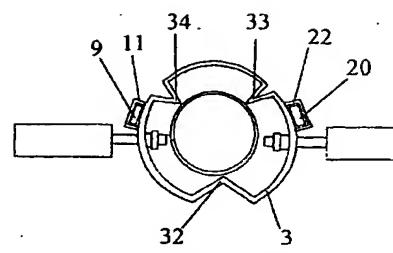


FIGURE 6

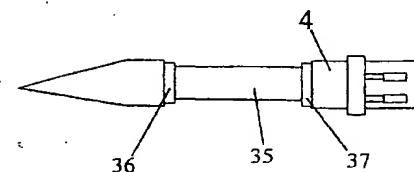


FIGURE 7

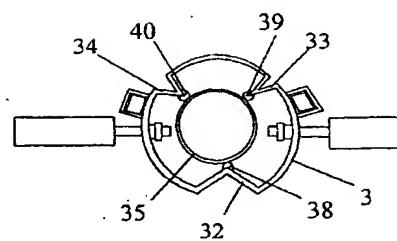


FIGURE 8

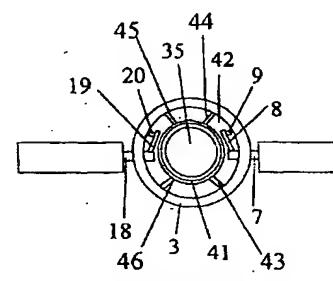


FIGURE 9

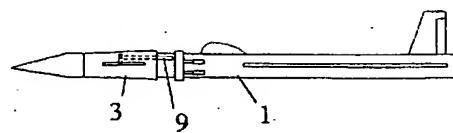


FIGURE 9A

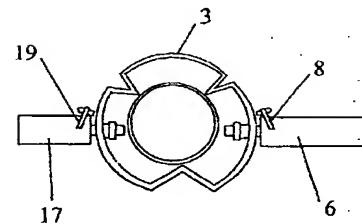


FIGURE 10

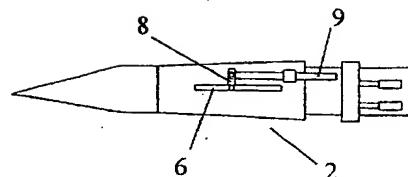


FIGURE 11

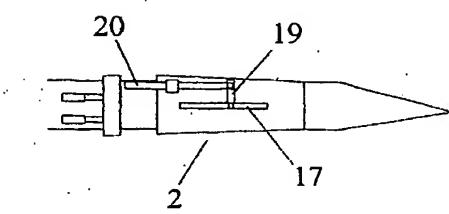


FIGURE 12

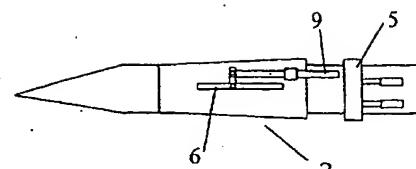


FIGURE 13

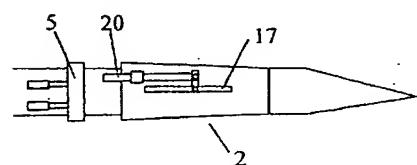


FIGURE 14

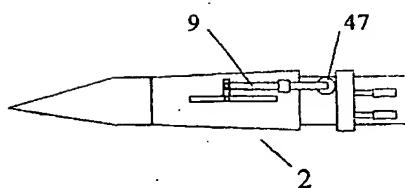


FIGURE 15

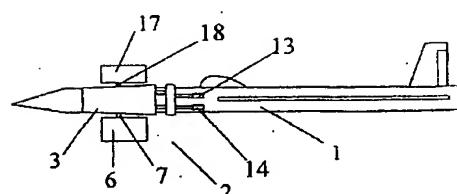


FIGURE 16

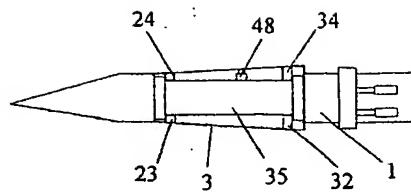


FIGURE 17

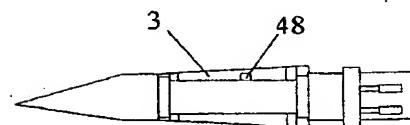


FIGURE 17A

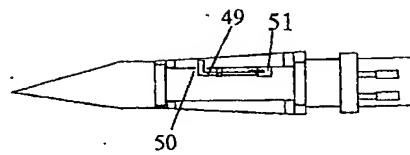


FIGURE 18

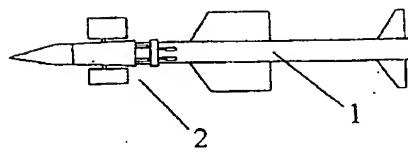


FIGURE 19

FIGURE 19

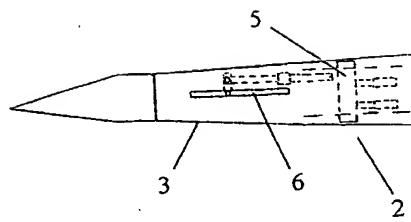


FIGURE 20